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Forest Pest Management Report

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BIOLOGICAL EVALUATION OF PEST CONDITIONS AND POTENTIAL HAZARD TREES IN SELECTED CAMPGROUNDS ON THE TONTO NATIONAL FOREST, ARIZONA

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MARCH 1990

By

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INTRODUCTION

In 1989, Forest Pest Management in Region 3 initiated an insect and disease Incidence Survey of recreation sites. These surveys were designed to evaluate the overall "health" of proposed and existing campground areas on the National Forests. A list of areas to examine were supplied by Steve Gunzel, District Ranger, of Payson Ranger District (RD), and Jim Soeth, District Ranger, of Pleasant Valley RD. The information supplied in this report offers pest management considerations for vegetation management plans. The areas surveyed include:

Ranger District	Campground (CG)	Status
Payson	Zane Grey	New
	Lower Tonto	Existing
	Upper Tonto	Existing
Pleasant Valley	Canyon Creek	New
	Airplane Flat	New
	Colcord Ridge	New
	Valentine Ridge	Reconstruction

OBJECTIVES

The objectives of this survey were to: (1) Evaluate and document the incidence of insect and disease activity and damages in proposed and existing recreation sites, and (2) detect and document hazardous trees in developed sites.

METHODS

The procedures followed are described in the "Inventory of Insects, Diseases, and Hazard Tree Incidence Work Plan for Developed and Proposed Recreation Sites of National Forest System Lands, Southwest Region" (Rogers, 1989). The study within each recreation area was two part; an insect and disease survey and a hazard tree analysis. The insect and disease survey was performed as a Region 3 Stage II Stand Exam Survey described in the Region 3 Silvicultural Examination and Prescription Handbook, FSH 2409.26d. The following data were collected for each tree recorded from each sampling point: Species, diameter at breast height (DBH), height, tree history, a damage code, and a code for dwarf mistletoe rating (DMR) (Hawksworth, 1977). The data was recorded on the Region's Forest/Stand Tree Record Sheet and run through the Region 2/3 Stage II Data Entry/Runstream Generation Program. The runstreams were submitted to Fort Collins Computer Center for processing. Stand examinations were not performed in either Tonto Creek CG, as only hazard tree analysis was performed in these areas.

The hazard tree analysis was patterned on procedures described by Johnson

(1981). A hazard tree is defined as any tree with both a mechanical defect that could cause the tree to fail and a potential target. For the hazard tree survey, only trees showing structural defects and located in areas of intensive public use, e.g. within and adjacent to camping sites, toilets, and parking pads, were evaluated. The individual tree data included: Species, diameter inside bark (DIB), location, defect, and hazard rating, which was recorded on a Tree Hazard Evaluation Form (see Appendix A). Dwarf mistletoe infection was indicated on maps for each site.

The hazard rating system used is a two-part failure/risk rating system, each part using a descriptive rating scale of High (H), Medium (M), and Low (L) to estimate probability. The first part of the rating system is an estimate of the probability of mechanical failure of the tree, or major portions of the tree, within the next five years. This estimate is based on a number of factors including: Presence of decay, condition and location of roots and crowns, and amount of lean. The second part of the rating is an estimate of the probability of injury to people or damage to property if the tree does fail. Only trees located in areas more likely to be occupied by people or property (risk rating = high or medium) were recorded on the evaluation forms. Hazard tree analysis was done only in Upper and Lower Tonto Creek CGs, since these are the only fully developed sites examined during this survey. Hazard tree surveys should be done in the proposed campgrounds once final site designs are completed.

RESULTS AND DISCUSSION

Most sites surveyed are composed of ponderosa pine mixed with a few scattered oak and juniper species. Six hazard trees (five pine and one oak) were recorded between the two Tonto Creek CGs (Table I), and one hazard tree was observed in Valentine Ridge CG (see below). The majority of trees examined were dead or had dead tops or limbs and were rated in the high-medium failure/high risk category. The hazard ratings provided are not recommendations for action. They are a professional estimate of the probability of tree failure and should be used by the land manager during the decision-making process for management plans in recreation areas. Specific information on recorded hazard trees and their location is supplied in the Tree Hazard Evaluation Forms for each site in Appendix A and treatment considerations are offered under Management Alternatives.

Table I. Summary of hazard trees by rating class for each recreation site surveyed on the Tonto National Forest.

	Number of Trees with Rating of:					
Campground	H/H[a]	M/H	H/M	L/H	L/M	TOTAL
Upper Tonto		2				2
Lower Tonto	3				1	4
Total	3	2			1	6

PA = Picnic Area; CG = Campground; GC = Group Camp

[a] Failure/Risk Rating: H = High; M = Medium; L = Low

Table II. Information from Stage II stand examinations of some recreation sites on the Tonto National Forest.

Campground		Understory	Overstory	Total
Zane Grey	QSD[a]	4.6	13.8	5.5
	BA[b]	19	9	29
	#stem[c]	166	9	175
Upper Canyon	QSD	13.0	26.2	15.3
	BA	57	34	91
	#stems	63	9	71
Airplane Flat	QSD	14.0	24.0	15.9
	BA	86	42	128
	#stems	80	13	94
Colcord Ridge	QSD	7.2	20.8	8.8
	BA	58	35	94
	#stems	206	15	221
Valentine Ridge	QSD	5.0	18.7	6.3
	BA	59	42	101
	#stems	438	22	460

[a]QSD=quadratic stand diameter

[b]BA=basal area/acre

[c]#stems=#stems/acre

Table III. Dwarf mistletoe ratings (DMR) of some recreation sites on the Tonto National Forest.

	DMR[a]			DMC[b]
Campground	understory	overstory	total	
Zane Grey	.9	1.9	.9	7
Upper Canyon	0	0	0	0
Airplane Flat	.3	.5	.3	2
Colcord Ridge	1.3	1.9	1.4	9
Valentine Ridge	.5	2.5	.6	9

[a]DMR = Hawksworth's (1977) dwarf mistletoe rating

[b]DMC = Dwarf mistletoe class system (see text)

Tables II and III summarize information from the stand examinations. Site densities are similar with the exception of the proposed Zane Grey CG which shows a very low BA (29) due to the high rate of manzanita and other nontimber species. Southwestern dwarf mistletoe (DM) (see Biology of Pests) was the only pest observed causing significant damage.

Zane Grey - The high DMR (Table III) in Zane Grey represents severe DM

infection of the ponderosa pine stand located at the southern edge of the site (Appendix B). Both the overstory (DMR = 1.9) and understory (DMR = .9) are severely infected. In developing site plans for this area, we strongly advise evaluating treatment alternatives which will decrease intensity of infection and enhance vigor of the stand (see Biology of Pests). Areas to be cleared for camping sites could center around severely infected trees (DMR = 4-6), so they will be removed. Pruning DM brooms on less severely infected trees (DMR = <4) will increase their longevity.

All of the Pleasant Valley RD sites are popular campground areas which will be developed over the next five years to include toilet facilities, picnic tables, and fire pits. Picnic tables and a few grills have been placed in the Valentine Ridge site. Risk of bark beetle outbreak in these campgrounds is low at the reported stocking levels (Demars and Roettgering, 1982), in which BA's ranged from 91 in Upper Canyon Creek to 128 in Airplane Flat. Dwarf mistletoe infection was not found in Upper Canyon Creek but was observed in the other three sites surveyed on this RD.

Airplane Flat CG - This campground is adequately stocked with seedlings, saplings, poles and sawtimber-sized ponderosa pine. Although the DMR for the entire site is low (Table III), there are pockets of high DM infection in the ridge area (Appendix B), especially in overstory trees. Treatment alternatives to decrease DM infection should be evaluated, especially as a preventive measure to increase the health of the stand. Pruning the brooms on trees with DMR <4 will increase the longevity of these trees. Removing some of the severely infected trees (DMR >3) will limit spread of disease to the understory.

Colcord Ridge CG - Composed of large and small yellow pines with clumps of poles. There is a small oak component on this site and very little pine regeneration. All size classes of pine are infected with DM, but infection is most severe in the overstory trees (Appendix B). During the development of site plans for this campground, we advise an emphasis on treatments which will decrease the level of DM infection and increase the health and longevity of the trees. Broom pruning, removal of some severely infected trees, and/or ethephon treatments should be evaluated (see Biology of Pests).

Valentine Ridge CG - All size classes of ponderosa pine are represented on this site. Dwarf mistletoe infection is distributed throughout the area and most severe in the overstory trees (Appendix B). Again, DM treatment should be considered to decrease the level of infection in specific trees (i.e., broom-pruning) and in the overall stand (i.e., thinning out infected trees in pockets of regenerating seedlings, saplings, and poles). One large dead-and-leaning ponderosa pine, with a sizeable basal cavity is a hazard to one of the established campsites (Appendix B). This tree should be removed.

BIOLOGY OF PESTS

Southwestern Dwarf Mistletoe - Arceuthobium vaginatum subsp. cryptopodum:

Southwestern dwarf mistletoe (SWDM) is the most damaging disease of southwestern ponderosa pine, Pinus ponderosa var. scopulorum Engelm, (Hawksworth, 1961). Dwarf mistletoes are parasitic, seed-bearing plants that

depend on their hosts almost completely for their water and nutrients. The disease spreads by explosively released seeds which are expelled to distances ranging from 10 to 40 feet. Seeds of SWDM are released in late July and early August. Infection follows a few months after dispersal, most taking place through the bark on needle-bearing portions of twigs. Dwarf mistletoes first produce an endophytic system, a specialized root-like structure that is in contact with the phloem and xylem of host trees, from which the parasite obtains most of its nutrients and water. The aerial shoots appear between two to five years after infection; this period of infection before shoots are visible is known as the latent period.

The disease causes mortality and growth reduction in infected trees: A decrease in the quantity, quality, and germination percentage of seeds produced; and lowers timber quality. Severely infected trees are more susceptible to attacks by insects and other diseases and to environmental stresses such as drought. Heavily infected trees (DMR = 5 or 6) may sustain a 20 to 50 percent reduction in growth when compared to uninfected trees and their life expectancy is severely decreased (Lightle and Hawksworth, 1973). Dwarf mistletoe infects trees of all ages and is thus a problem in second growth and regeneration, as well as mature and overmature stands.

Spread of SWDM is a function of stand density, age, and site index, and averages one to two feet a year. Spread is most efficient and rapid from an infected overstory to an understory and slowest through an evenaged stand. Management of SWDM is directed toward decreasing spread and intensification of disease since DM eradication is achieved only by removing the entire stand of trees.

The following suggestions for SWDM control in recreational forests are offered based on a 20 year study in Grand Canyon NP by Lightle and Hawksworth (1973):

-Pruning is recommended in lightly infected trees (DMR <3). Remove branches two whorls above highest DM-infected branch to insure against latent infections. No more than 50% of the live crown should be removed.

-Confine pruning to more isolated trees. Repruning has been required in densely stocked stands due to numerous latent infection in areas initially considered lightly infected.

-Infected branches should be cut off at the bole in order to insure removal of the endophytic, root-like, system in the host tissue.

-Trees with bole infections do not need to be killed since bole infections are not vigorous.

-Pruning witches brooms on heavily infected trees (DMR = 3-4) does prolong life. A shorter life expectancy corresponds to higher DMR.

Other management strategies include:

-Sanitize densely stocked stands. The most severely infected trees are removed to eliminate much of the inoculum and promote vigor of lightly and noninfected trees.

-Remove severely infected overstory trees. A vegetation management plan is desirable, with emphasis on nonhost species eventually replacing DM-infected trees.

-Apply ethylene-releasing chemicals to promote abscission of DM aerial shoots (Beatty, et.al., 1988; Nicholls, et.al., 1987). This method greatly reduces seed dispersal; the pathogen is not eliminated since the endophytic system remains viable within the host tissue and new aerial shoots form in two to five years. Chemicals need to be reapplied every few years, making this method suitable to high value areas where susceptible trees have been established under an infected overstory.

MANAGEMENT ALTERNATIVES

1. Do nothing. Trees rated as potential hazards will continue to decline and the probability of failure will increase. Trees will continue to be damaged by campers and by natural causes, so the number of potential hazards will also increase. The possibility of tree failure with property damage and injury to people will increase. Dwarf mistletoe-infected trees will continue to decline in health and vigor and serve as inoculum for spread and intensification of disease. Risk of mortality will exist on densely stocked sites, especially those severely infected with DM, due to susceptibility to attack by bark beetles.

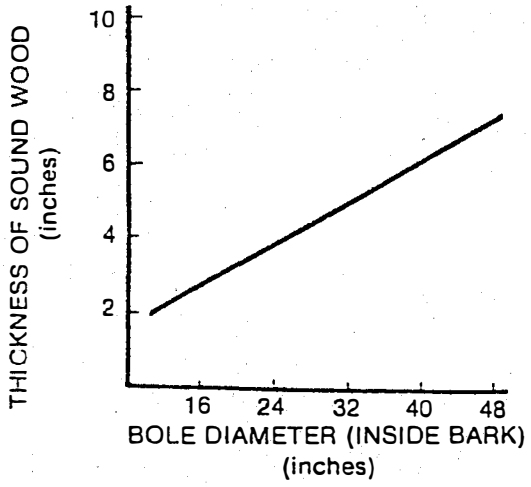


Figure I. Thickness of sound wood in outer shell required to maintain 66% of original strength in trees with heart rot (from Johnson, 1981). If the amount of sound wood exceeds that established by the line on the graph, the tree is considered relatively safe from failure.

2. Remove or lessen the probability of failure of hazard trees. The land manager must decide the level of risk acceptable in an area and hazard trees would be removed or treated until that risk level is reached. In many cases, pruning dead branches or DM brooms would substantially reduce the probability of failure. Dead tops on conifers should be removed as soon as practical (Mills and Russell, 1981). For trees showing signs of internal decay, the thickness of sound wood in the outer shell determines relative safety (Figure 1). Trees that lean naturally usually are reinforced by compensatory growth. However, structural damage to leaning trees, such as severed roots, large basal cavities, and internal decay increase the probability of failure and threaten visitor safety (Johnson, 1981).

3. Remove the targets. Under this alternative, campgrounds or selected areas within campgrounds that are identified as targets are closed to public use. Removal of potential targets will remove the problem of hazard trees.

4. Develop a vegetation management plan which reduces incidence of insect and disease and development of hazard trees. This may include activities such as: Thinning a dense stand of trees which reduces stress and probability of bark beetle attack; sanitizing to decrease the incidence of DM infection; pruning DM-infected trees to prolong life; and planting nonhost species under an infected ponderosa pine overstory.

5. A combination of alternatives 2 and 3 and 4. These alternatives are not mutually exclusive and can be used in combination to solve specific problems in many areas.

REFERENCES

Beatty, J.S., H. Maffei, E. Collins, and M. Christian. 1988. Ethephon tests for ponderosa pine dwarf mistletoe in New Mexico. Proceedings of the 36th Western International Forest Disease Work Conference, p. 39-40.

Hawksworth, F.G. 1961. Dwarf mistletoe of ponderosa pine in the Southwest. U.S. Department of Agriculture Technical Bulletin 1246, 112 p.

Hawksworth, F.G. 1977. The 6-class dwarf mistletoe rating system. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, General Technical Report RM-48, 7 p.

Johnson, D.W. 1981. Tree hazards: recognition and reduction in recreation sites. USDA Forest Service, Rocky Mountain Region, Lakewood, Colorado, General Technical Report R2-1, 17 p.

Lightle, P.C., and F.G. Hawksworth. 1973. Control of dwarf mistletoe in a heavily used ponderosa pine recreation forest: Grand Canyon, Arizona. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, Research Paper RM-106, 22 p.

Mills, L.J., and K. Russell. 1981. Detection and correction of hazard trees in Washington's recreation areas. A how-to guide for recreation site managers. State of Washington Department of Natural Resources. DNR Report No. 42, 37 p.

Nicholls, T.H., L. Egeland, F.G. Hawksworth, and D.W. Johnson. 1987. Control of dwarf mistletoe with ethephon. Proceedings of the 34th Western International Forest Disease Work Conference, p. 78-85.

Rogers, T.J. 1989. Inventory of Insects, Diseases, and Hazard Tree Incidence Workplan for Developed and Proposed Recreation Sites of National Forest System Lands, Southwest Region. Unpublished report. USDA Forest Service, Southwestern Region, Albuquerque, New Mexico, 38 p.

APPENDIX A

TREE HAZARD EVALUATION

EXHIBIT 8

Administrative unit Payson RD

Examined by TS, JR, MLF

Site name Lower Tonto CK CG

Date & 6-26-89

Campground or Picnic Unit No.	Tree location (azimuth and distance from fixed object)[1]	Species	D.I.B.	*See abbreviations Type of defect: Leaning (angle of lean °)	Uprooting, root rot, butt rot, basal cavity	Bole wounds, bole cankers, decay (conks)	Weak fork, limb defect, brooms, dead top	Potential targets: Permanent structure, parked vehicle, people	Temporary structure, high-use trails	Low-use trails, signs	Failure rating[2]: High	Medium	Low	Risk rating[3]: High	Medium	Low	Additional comments	Actio
	Abbreviations: TO=Toilet, TB=Table, FR=Fire ring, PP=Parking pad, TP=Tent Pad, WH=Water hydrant, BG=Bridge, TC=Trash can, TD=Trailer dump																*Defect abbreviations: RR=Root rot, BR=Bole or butt rot, BW=Bole wound, BC=Basal cavity, LD=Limb defect, WF=Weak fork, C=Conk(s), DT=Dead top, ER=Exposed roots	10
1	TB 104° 46'	PP	5		Dead tree		leaner	X			X			X				
4	FR 34° 19'	PP	19				X	X			X			X			Dead branches	
5	TB 197° 12'	PP	4		Dead tree			X			X			X				
13	TB 146° 47'	PP	11	40°				X					X		X		Leaning over road	

1 Sketch map on reverse side.
2 Probability of a tree failing within the next 5 years.
3 Probability of a tree hitting a potential target.

TREE HAZARD EVALUATION

EXHIBIT 8

Administrative unit Payson RD

Examined by IS, TR, MLF

Site name Upper Tonto CK CG

Date 6-23-89 & 6-26-89

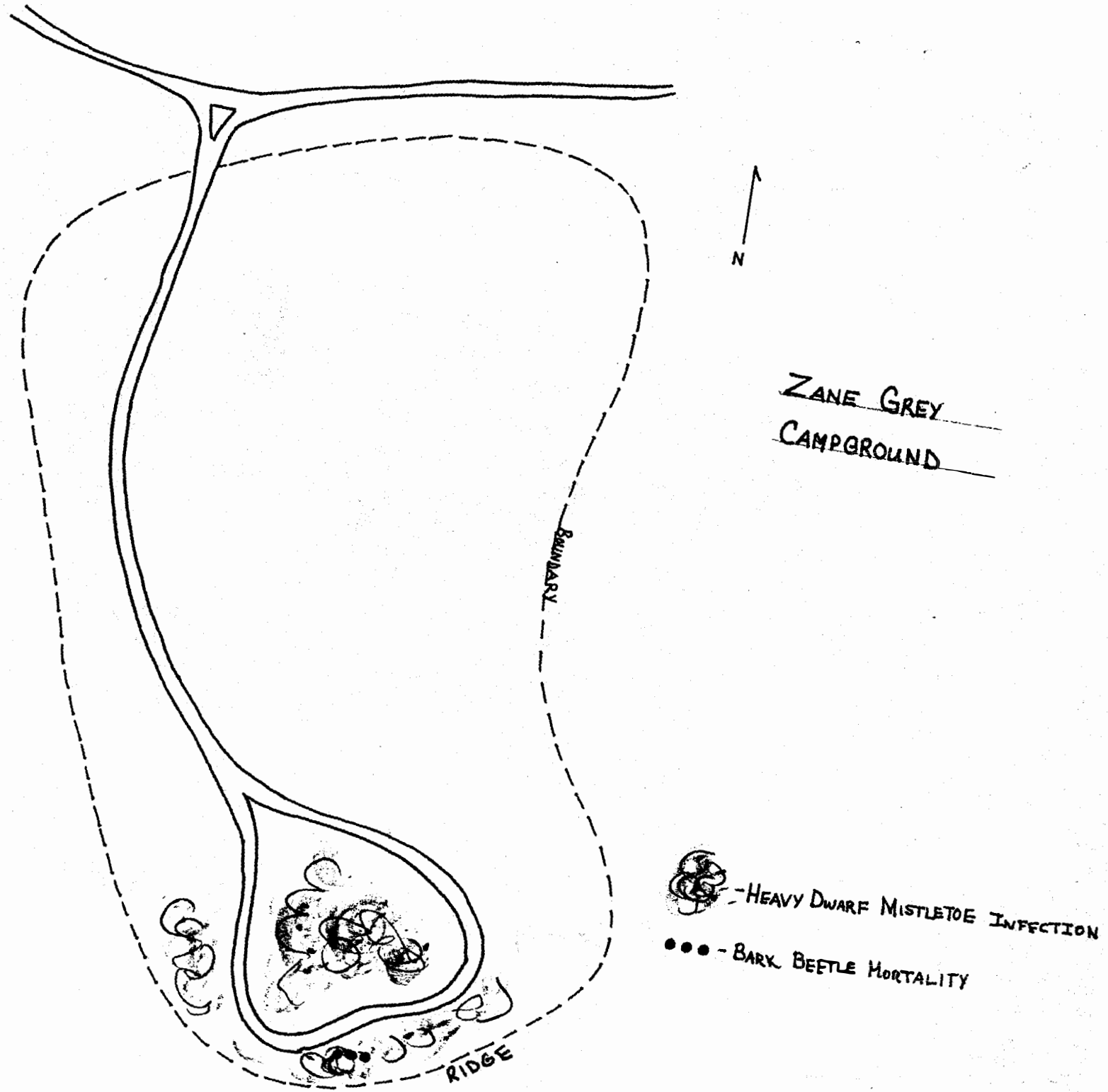
Campground or picnic unit No.	Tree location (azimuth and distance from fixed object)[1] Abbreviations: TO=Toilet TB=Table FR=Fire ring PP=Parking pad TP=Tent Pad WH=Water hydrant BG=Bridge TC=Trash can TD=Trailer dump	Species	D.I.B.	*See abbreviations Type of defect: Leaning (angle of lean °)	Uprooting, root rot, butt rot, basal cavity	Bole wounds, bole cankers, decay (conks)	Weak fork, limb defect, brooms, dead top	Potential targets: Permanent structure, parked vehicle, people	Temporary structure, high-use trails	Low-use trails, signs	Failure rating[2]: High	Medium	Low	Risk rating[3]: High	Medium	Low	Additional comments	Actio
																	*Defect abbreviations: RR=Root rot BR=Bole or butt rot BW=Bole wound BC=Basal cavity LD=Limb defect WF=Weak fork C=Conk(s) DT=Dead top ER=Exposed roots	
7	TB 45° 26'	AS	10				X	X				X		X				
5	TB 197° 21'	PP	7	27°				X				X		X				

1 Sketch map on reverse side.

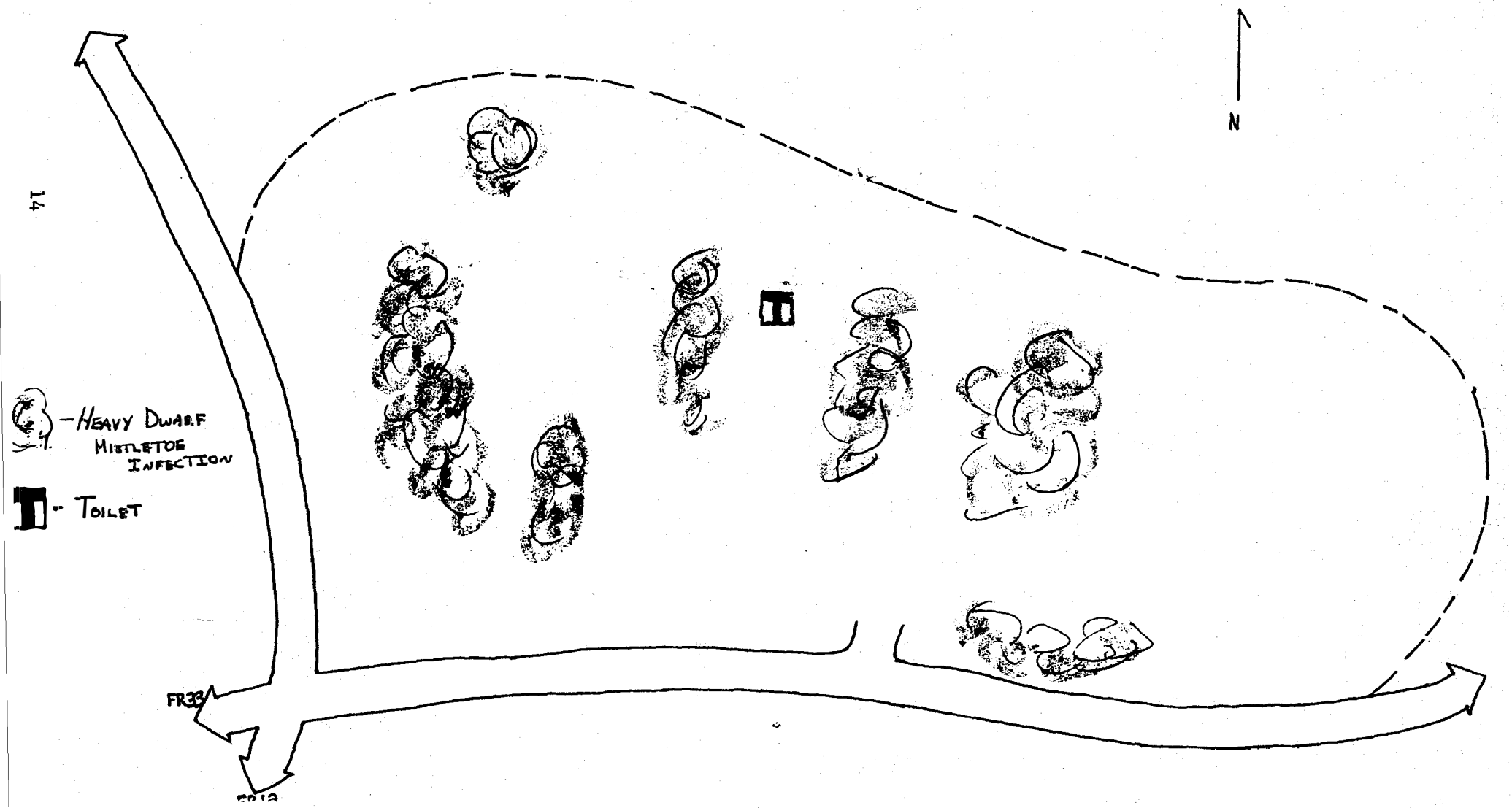
2 Probability of a tree failing within the next 5 years.

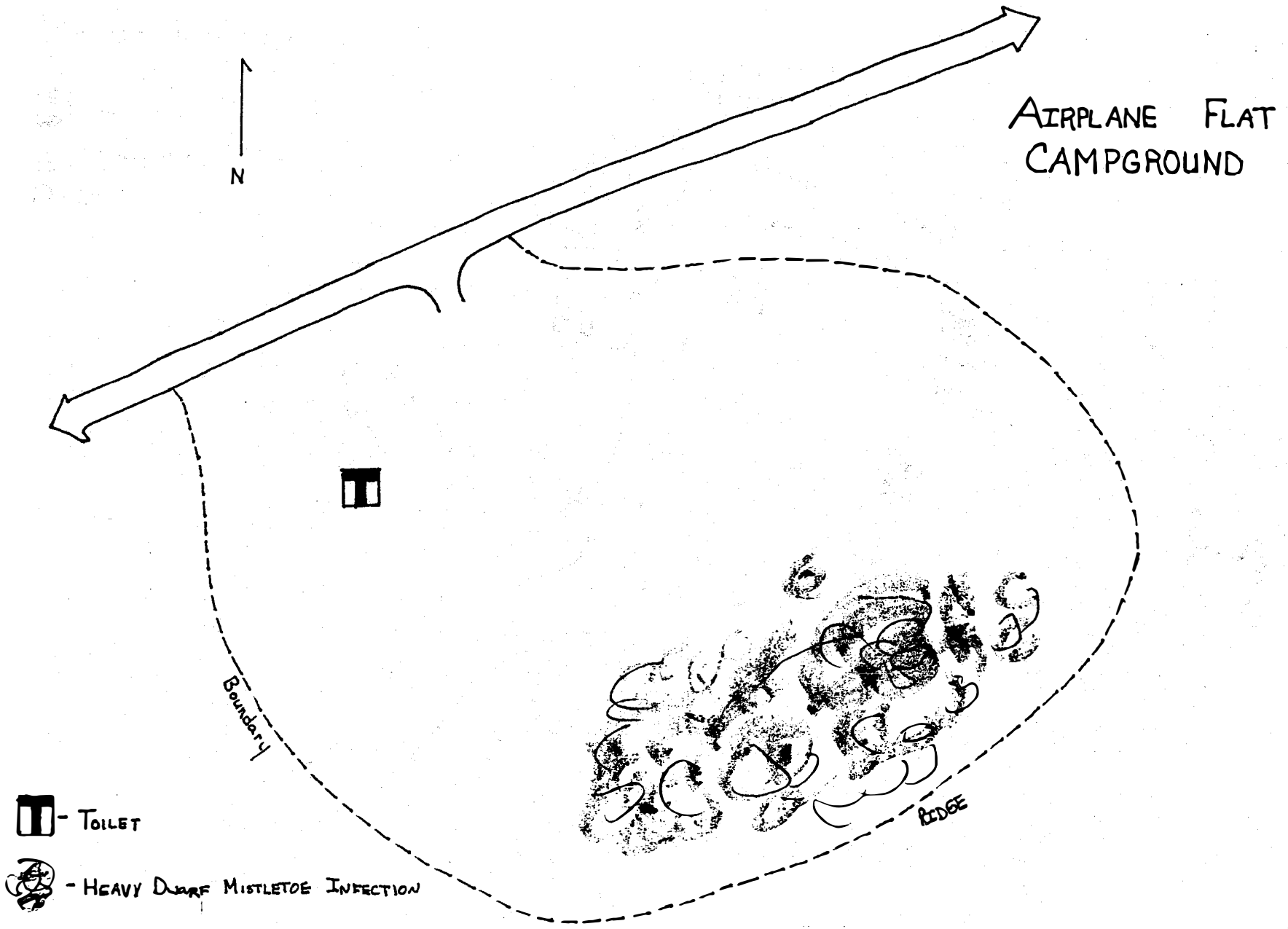
3 Probability of a tree hitting a potential target.

APPENDIX B

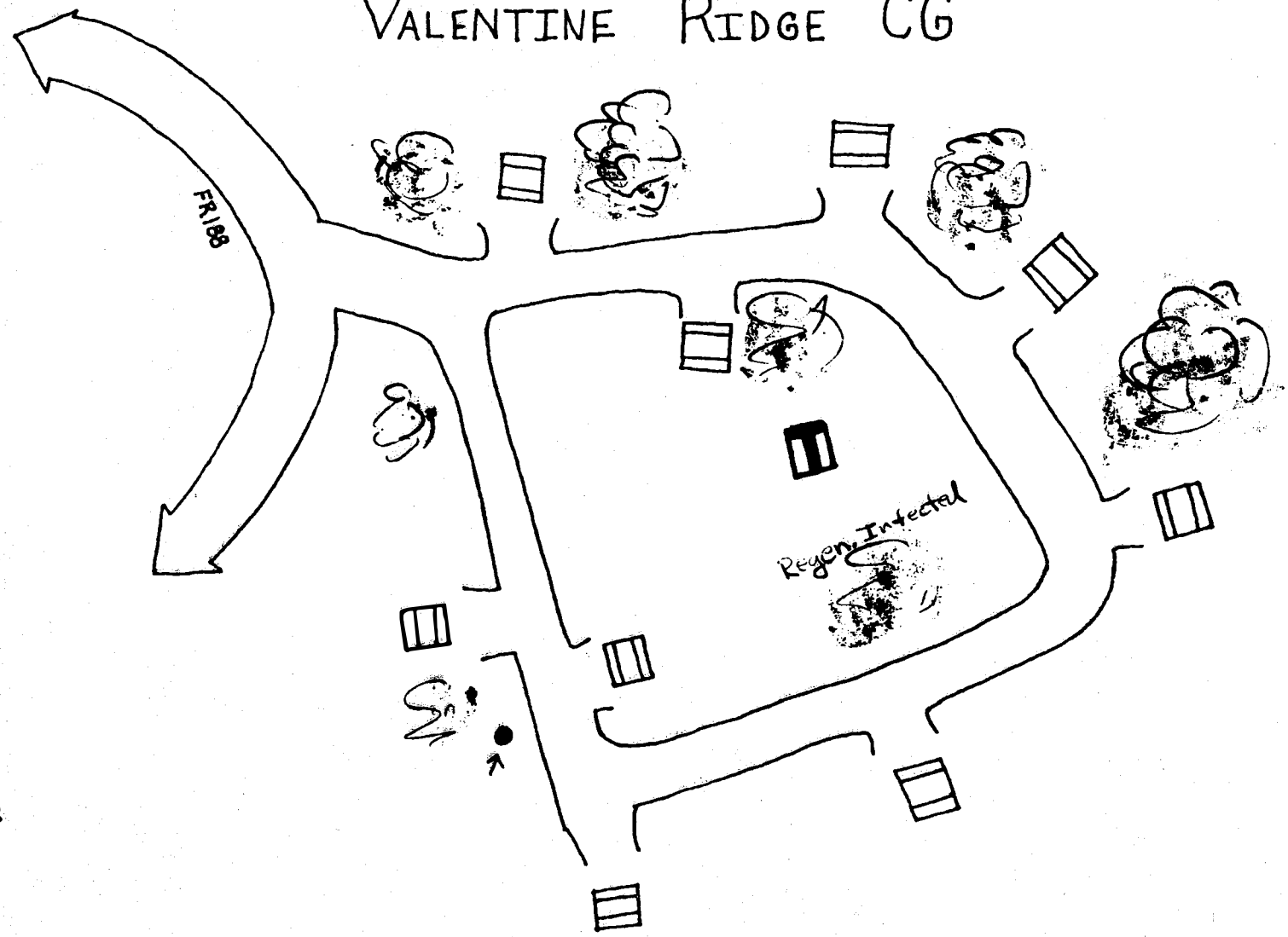

N
ZANE GREY
CAMPGROUND
BOUNDARY
RIDGE
- HEAVY DWARF MISTLETOE INFECTION
- BARK BEETLE MORTALITY

Upper Colcord Ridge (Proposed Campground)




AIRPLANE FLAT
CAMPGROUND
N
BOUNDARY
RIDGE
- TOILET
- HEAVY DWARF MISTLETOE INFECTION

VALENTINE RIDGE CG



LEGEND

- PICNIC TABLES
- TOILET
- HEAVY INFECTION
- HAZARD TREE